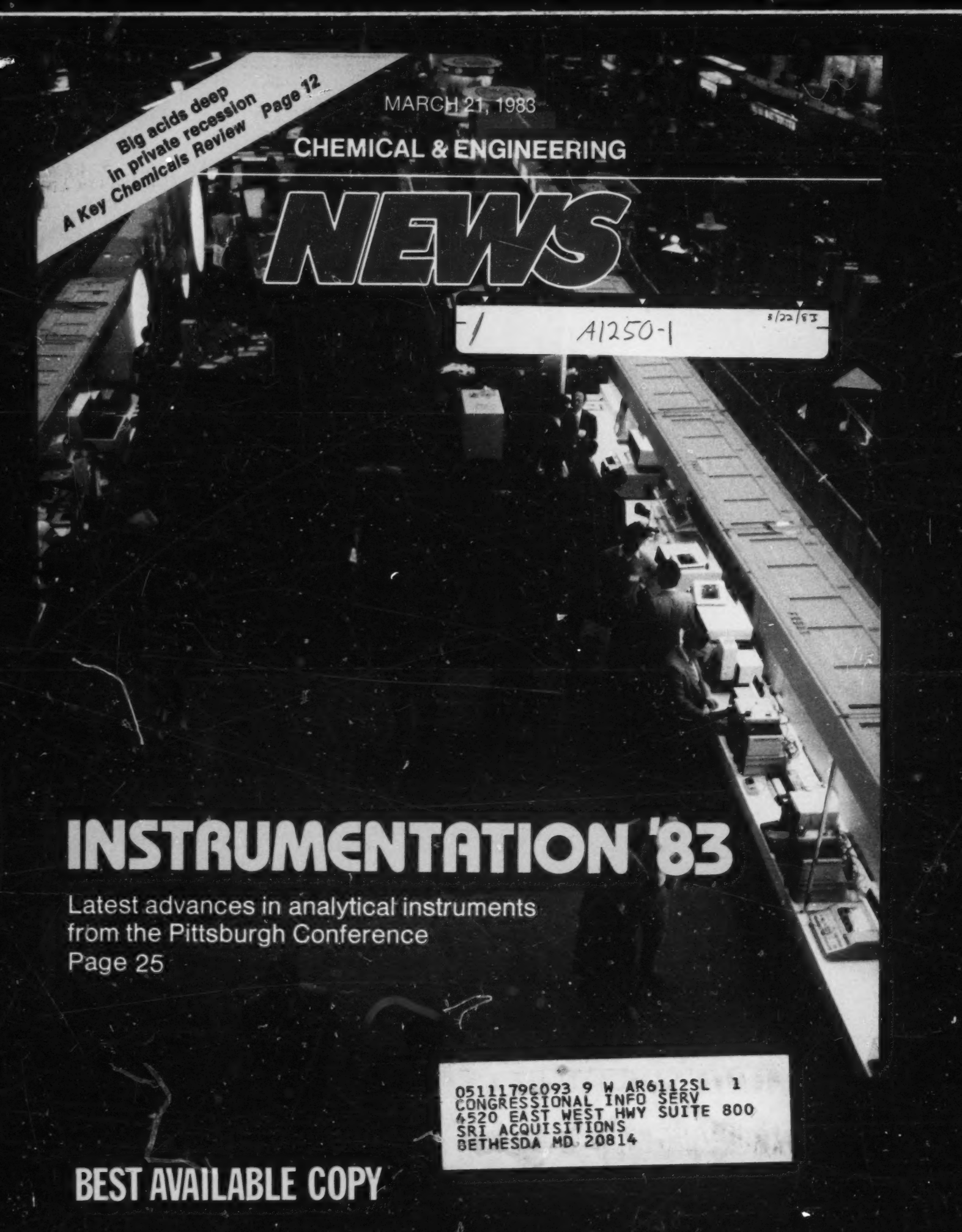
Big acids deep in private recession
A Key Chemicals Review Page 12
MARCH 21, 1983
CHEMICAL & ENGINEERING
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CHEMICAL & ENGINEERING NEWS

MARCH 21, 1983

News of the Week

■ **Toxic waste protection may get more stringent rules with bill soon to be introduced.** **Page 6**

■ **OPEC quits squabbling and agrees to reduce oil prices and lower production ceiling.** **Page 7**

■ **Troubles continue at EPA with charge of suppression of information of dioxin contamination.** **Page 7**

■ **Phillips gets long-awaited patent for polypropylene.** **Page 7**

■ **Demand for farmers will exceed supply, says USDA report.** **Page 8**

■ **Meteorite found in Antarctica may be a piece of the Moon.** **Page 8**

Business

Big-volume sulfuric and phosphoric acids are stuck in recession with little hope of recovery in 1983; main problem stems from difficulties for phosphate fertilizer. **Page 12**

Government

International trade issues facing Congress will affect chemical industry's trade balance; long-term solutions sought. **Page 16**

Science

Number of women earning Ph.D.s in science has doubled in past four years, but discrepancies in salary and tenure remain, says updated National Research Council report. **Page 21**

Education

New masters degree program to train technical and scientific managers is gearing up at Rensselaer Polytech. **Page 23**

Letters 4
Editor's Page 5

Concentrates
Business 10
Government 15
Science/Technology 18

The Departments
New Products 54
ACS Comment 71
People 72
Newscripts 86

Special Report

New instrumentation at this year's Pittsburgh Conference points up the increasing role the computer is playing in the analytical laboratory. **Page 25**

Big-Volume Acids' Recession Likely To Continue

Sulfuric and phosphoric acids have little hope of joining general economic recovery in 1983; farm acreage controls hurt giant fertilizer market

Bruce F. Greek, C&EN Houston, and
William F. Fallwell, C&EN Washington

After living a charmed life in the first two years of the U.S. chemical industry's travails since 1979, big acids producers have lumbered into a private recession that could stretch far into the general economic recovery now getting under way.

Everything has gone wrong for sulfuric and phosphoric acids, whose woeful immediate market prospects are detailed in the following pages. And that means a significant part of the chemical industry will remain financially depressed. Sulfuric acid ranks number one and phosphoric acid number nine in production volume among all U.S. basic chemicals. Nor are these two chemicals small potatoes in value, with a combined $4.25 billion estimated for 1983.

This value figure, however, neatly sums up the acids' problems. It is fully 40% off the $7 billion these giant inorganics were worth in the recent boom years around 1980. Obviously, prices have been smashed. And production has tumbled, a combined 27% from the 1980 peak, to the trough of 40.2 million tons (phosphoric acid measured as P_2O_5) in 1982. Even with a hopeful 3% production gain in 1983, volume will remain 24% below the recent peak. Average plant use will languish at 60% of total capacity.

Key Chemicals

Behind these doleful statistics is one main problem for both products: big trouble on farms around the world. The unremitting agricultural recession in the U.S. and abroad means a similar recession for phosphate fertilizer, which consumes 85% of U.S.-produced phosphoric acid and 70% of sulfuric acid. Even an unexpected turnaround for U.S. agriculture wouldn't save the acids completely, because nearly half of U.S. phosphoric acid winds up eventually in exports, and about two thirds of sulfuric acid goes into phosphoric acid.

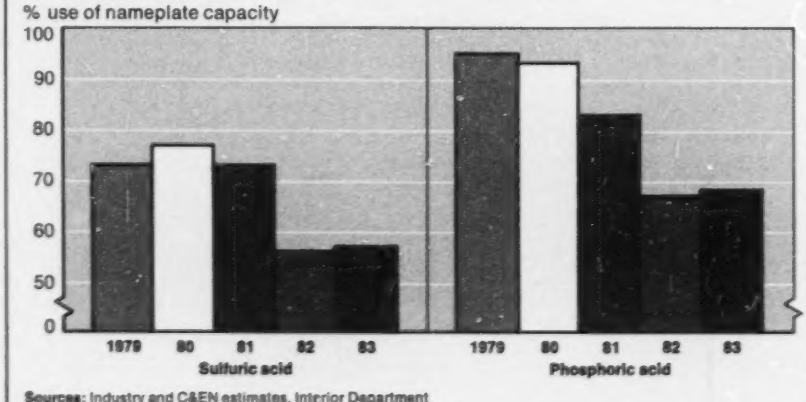
The latest twist in the U.S. fertilizer market is the government's new acreage control effort called Payment-In-Kind, or PIK, whereby farmers are paid in cash and inventoried goods for the crops they don't grow. By attempting to shrink the product oversupply, PIK is hence both a price support and acreage reduction program. Its first test is the deadline just passed for farmers to sign up. Results are due shortly.

Theoretically, PIK could push fertilizer volume either way. Farmers might actually overfertilize remaining planted acreage to increase productivity, some analysts speculate. However, the more likely result is that, if unplanted acreage turns out to be a large percentage of the total, and farmers' financial plight is unrelieved, fertilizer use will continue to drop. Conservative forecasters predict a 10% cut in phosphate fertilizer use in the U.S. in 1983, largely because of PIK.

Then there's the export problem. It is exacerbated at the moment by the enormous debt loads in developing countries such as Brazil and India, which are some of the largest buyers of U.S. phosphoric acid and phosphates. For the future, U.S. products will face mounting competition from phosphates about to pour out of new production centers such as Morocco and other North African countries.

Put it all together and analysts fear that the big acids may have a long wait, possibly until the mid-1980s, for a return to high plant use and healthy profitability.

Plant use will remain very low in both acids



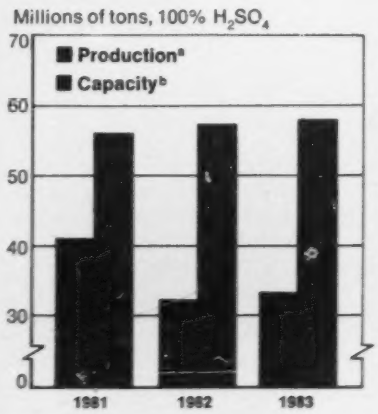
Sources: Industry and C&EN estimates, Interior Department

Sulfuric Acid

H_2SO_4

- ***Demand low***
- ***Capacity facing drop***
- ***Prices discounted***

PRODUCTION/CAPACITY



a From all sources. b First quarter.

HOW MADE

Sulfur dioxide from burning sulfur or from smelter gases oxidized and reacted with water

MAJOR END USES (U.S.)

Fertilizer 70%; chemical manufacture, metals processing and petroleum refining, 5% each

FOREIGN TRADE

Exports—up to 250,000 tons in 1983; imports—possibly 500,000 tons in 1983, mainly from Canada

PRICES

List prices $55 to $80 per ton depending on location, with heavy discounting; smelter acid priced much lower

COMMERCIAL VALUE

$2 billion for production, 1983

The old, perhaps outdated, adage that as sulfuric acid goes, so goes the chemical industry, applied very well in 1982. A more than 20% decline in demand for this ubiquitous acid last year hinted correctly that all parts of the chemical industry had a bad time. More directly, the decline underscored the fact that the acid's dominant market, phosphate fertilizer, was a shambles.

Since prospects for the chemical industry are for improvement in 1983, the outlook for sulfuric acid is that output will be up modestly. Subject to many "ifs," acid production is expected to increase no more than 5% over 1982 production of about 32 million tons (as 100% H_2SO_4). It's likely, say industry analysts, that the increase will be about 3% to bring production to 33 million tons. So output still will be down sharply from 1981's 40.8 million tons and from the previous peak of 44.2 million tons in 1980.

A production decline of more than 25% in two years obviously has hurt sulfuric acid producers. Substantial plant capacity, up to 5%, has been shut down—an unusual event for the nonsmelter acid part of the industry. (Smelter acid usually fluctuates more in plant shutdowns and startups because this acid is a by-product of metals production.) Ordinarily, acid plants keep running even in times of low demand to minimize corrosion.

With substantial capacity down, notably in plants supplying acid for reaction with phosphate rock to make fertilizer-grade phosphoric acid, controversy has begun in earnest about real future acid capacity. Producers won't say that they have actually scrapped plants. Most likely, plants headed for the padlock over the next few years will slip away quietly, making capacity estimates undoubtedly too high.

Excluding smelter acid plants, sulfuric acid capacity now shut down is estimated at 1 million to more than 3 million tons per year. The higher figure is more than 5% of total first-quarter 1983 capacity of 57.5 million tons. Much of the remaining capacity, especially plants making acid for industrial uses, is running at low rates. Unfortunately, if smelter operations pick up as a result of higher copper demand, smelter acid will come to market at low prices and tend to hold down operating rates longer for plants making virgin acid.

If sulfuric acid production reaches 33 million tons in 1983, the plant operating rate will average less than 58% of first-quarter nameplate capacity. If, say, 2 million tons of capacity remains shut down all year, the operating rate for plants actually running still will not top 60%. Needless to say, business will be poor. That percentage figure for capacity use also makes it pretty clear that expansion money won't be around for some time.

Barring an unexpected surge in demand for phosphate and other fertilizers, sulfuric acid demand growth will stay 5% or lower per year, industry sources forecast. Therefore, production won't equal the 1980 level again until after 1985. A few capacity additions might come along, mostly captive plants, but much more old capacity will be gone by then. Operating rates will rise as a result, but hardly enough to help profitability.

Other than some improvement in the phosphoric acid market, prospects for greater sulfuric demand in 1983 are small. For instance, sulfuric's steel market may recover a bit, but the upturn is not expected to be large enough to help sulfuric acid output much. The situation is similar in other uses such as petroleum refining and chemical manufacture. A few of the small miscellaneous uses might be up significantly, as much as 10%, but their effect on sulfuric acid volume would hardly be noticeable.

Sulfuric's large overcapacity, especially in the Northeast, will keep downward pressure on prices. In turn, acid producers will keep pressure on raw material sulfur prices. Unfortunately, roughed-up sulfur pricing can work unfavorably for acid producers, whose customers will then expect savings to be passed on along. Hence, low raw materials' prices may not help acid producers' profit margins. In fact, further miserable pricing for sulfuric acid could hasten plant shutdowns and scrappage this year and next.

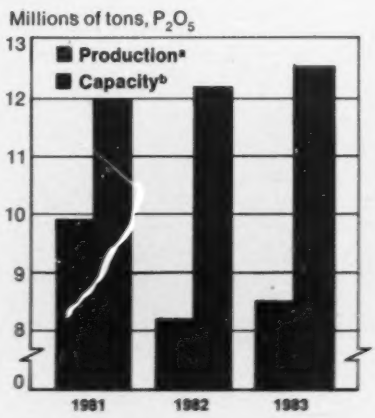
Overall, sulfuric acid faces scant letup in its own recession, even though the U.S. economy seems to be recovering. A pickup in industrial uses won't overcome sulfuric's market woes in fertilizer.

Phosphoric Acid

H_3PO_4

- ***Demand weak***
- ***Capacity gain ended***
- ***Prices slashed***

PRODUCTION/CAPACITY



a Both wet-process and furnace acid.
b First quarter.

HOW MADE

Reaction of phosphate rock with sulfuric acid; burning of elemental phosphorus and subsequent reaction with water

MAJOR DERIVATIVES (U.S.)

Ammonium phosphates 60%, triple superphosphate 20%

MAJOR END USES (U.S.)

Fertilizer 85%, detergents

FOREIGN TRADE (as acid)

Exports—falling below 1 million tons (as P_2O_5); imports—very small

PRICES

List prices $300 to $320 per ton for fertilizer; heavy discounting

COMMERCIAL VALUE

$2.25 billion for production, 1983

As the phosphoric acid world began to bristle with new investment during banner years in 1979 and 1980, some skeptical heads began to shake in consulting and banking circles. Unfortunately, the outsiders' cautionary advice was not heeded, and phosphoric acid today is deep in overcapacity woes as the market tumbles.

If that weren't enough, phosphoric acid producers have to tolerate some of the worst unknowns in all chemical marketing because of their dependence on farm markets—involving weather, strength of the dollar (affecting exports), farm commodity prices, and planted acreage. At the moment, these fickle influences are hurting phosphoric acid's major outlet in phosphate fertilizer, whose volume is well off this year. Minor, currently more stable, influences on the total phosphoric acid picture come from industrial, detergent, and food and beverage uses of specialized, generally purer acid made from elemental phosphorus.

The result of the unknowns in agricultural demand for phosphoric acid, plus a bit of optimism from industrial and other demand, is a slightly improved outlook, say analysts. For 1983, they put production of phosphoric acid at about 8.5 million tons (measured in terms of P_2O_5). That would be up less than 5% from a weak 8.2 million tons in 1982. Last year's output was off fully 17% from 1981's 9.9 million tons. So even a slight upturn in production in 1983—a controversial prediction at that—would leave phosphoric acid depressed.

A second straight poor production year is having severe effects on producers. At the moment, substantial capacity is shut down even though the big spring marketing season is starting. No capacity additions other than minor debottlenecking and other efficiency improvements have been announced for more than a year.

Although some plants are shut down, little if any capacity has been scrapped so far, indicating that phosphoric producers, like farmers, always can hope their luck will change. Some of the currently shut-down plants may never run again, but owners don't yet hold this view.

Plenty of incentive exists for plant scrappage. In 1983, the average plant operating rate may be a lowly 68%, barely up from 1982. These rates are roughly the same as in past depressed periods such as the mid-1960s.

Parallels to that time are very much on the minds of today's managers in the wet-process phosphoric acid industry. Severe overcapacity then caused a virtual halt to plant expansion for six to seven years. During that time, demand for phosphoric acid continued to grow and then caught up with capacity in the 1974–75 and 1979–80 boom years. In 1979 and 1980, production ran above nameplate capacity at times, as fertilizer producers strained to meet demand in U.S. and fast-rising export markets. Then began the round of large capacity additions just completed. The obvious current question is: Are phosphoric acid producers facing another several years of waiting for demand to catch up to their expensive new capacity?

Long-term recovery in phosphoric acid demand is expected to depend entirely on agricultural markets, with fertilizer accounting for most of the recovery. Industrial uses of phosphoric acid have slipped from about 1 million tons per year (as P_2O_5) in the early 1970s to about 700,000 tons and are expected to hold there for some time. Animal feed uses climbed to more than 500,000 tons per year but are expected to hold there or rise very slowly.

For 1983, some industry sources say that growth in phosphoric acid production for fertilizer may have to come strictly from traders and other risk takers buying in at depressed prices for future inventory profits. Actual farm use of phosphate fertilizer probably will be down, possibly as much as 10%.

However, fertilizer production still could grow for two types of inventory building. In the first case, dealer inventories apparently dropped substantially in 1982 as use of fertilizer exceeded production. So dealers now may partially rebuild inventories, aided by lower interest rates.

In the second case, fertilizer exports declined in 1982 and are expected to show little improvement even with the help of lower oil prices. However, lower oil prices and economic recovery could boost exports in 1984, and traders could build inventory this fall to meet such sales.

Women With Ph.D.s Gaining Rapidly in Sciences

Study shows supply of women with doctorates in science is up 50% in past four years; salary, tenure problems, however, are continuing

Four years ago, when the National Research Council took its first look at the status of doctoral women scientists in academic institutions, it concluded that the number of women in such positions was increasing slowly but that there were sex differences in salaries and in the awarding of tenure.

This month the council published an update of that study. Instead of the slow increases of four years ago, women with Ph.D.s are now gaining rapidly in numbers in both academic and industrial sciences. In the past four years the total supply of women with doctoral degrees in science or engineering has increased 50%. However, the discrepancies in salaries between men and women Ph.D.s, and in the likelihood of achieving tenure in academic positions or managerial jobs in industry will continue.

The new report, like its predecessor, was prepared by NRC's Committee on the Education and Employment of Women in Science and Engineering. The committee continues to be headed by Lilli S. Hornig, executive director of higher education resource services at Wellesley College, and M. Elizabeth Tidball, professor of physiology, George Washington University Medical Center.

A new report was called for, the committee says, for several reasons. Since the first report, which covered trends in employment through 1977, the number of women scientists and engineers completing graduate school has grown much faster than the number of positions available at colleges and universities. The committee wanted to know whether women were disproportionately affected by the relative scarcity of academic jobs.

Also, the committee wished to find out whether the modest gains of women in the mid-1970s seen in the first survey had been sustained and whether the salary differentials observed in the earlier study still continue. Finally, the present study amplifies the earlier one by including an examination of the status of doctoral women scientists and engineers in industry as well as at academic institutions.

"The most striking change that has taken place since 1977 is the growth in numbers of doctoral women scientists," the report says.

"Among new doctorates, men and women have very similar characteristics, including the age at which they complete the Ph.D., the type of Ph.D.-granting department, and what their plans are for the immediate future," the report finds. "Males and females in the same field are about equally likely to opt for a postdoctoral appointment, or if they plan to be employed, will go into

Salary differential between men and women chemists is one of the largest

Field	Median salary		$ Difference	% Difference
	Women	Men		
Full professors				
Mathematics	$34,700	$36,700	$2000	5%
Physics	37,000	38,000	1000	3
Chemistry	**31,000**	**36,000**	**4400**	**12**
Medical science	35,900	42,100	6200	15
Other bioscience	34,100	36,700	2600	7
Psychology	34,500	37,700	3200	9
Economics	36,400	42,200	5800	14
Associate professors				
Mathematics	27,800	28,600	800	3
Physics	—	28,600	—	—
Chemistry	**27,000**	**28,700**	**1700**	**6**
Medical science	30,200	32,800	2600	8
Other bioscience	27,000	28,300	1300	5
Psychology	27,100	27,200	100	0
Economics	30,100	32,700	2600	8
Assistant professors				
Mathematics	22,400	22,600	200	1
Physics	22,500	23,300	800	3
Chemistry	**20,700**	**22,400**	**1700**	**8**
Medical science	25,100	28,000	2900	10
Other bioscience	22,000	23,200	1200	5
Psychology	22,400	21,600	800	(4)
Economics	—	24,100	—	—

Note: Salaries are for full-time employees at four-year colleges and universities in 1981. **Source:** National Research Council

industry or academe at similar rates."

Once employed, however, differences between men and women scientists begin to appear. At academic institutions, doctoral women scientists are still more likely than men to be employed as instructors or lecturers, positions from which they cannot be promoted or achieve tenure. In most fields, this discrepancy has grown since 1977. In chemistry, for example, 5.3% of the women, compared with 2.7% of the men employed in academe in 1977, were in these nontenure-track positions. In 1981, 7.0% of the women and 2.1% of the men held such positions.

Even women who are eligible for tenure take longer to achieve it, on average, than their male colleagues. In the 50 institutions that have the largest R&D expenditures, for instance, three fourths of the men who were assistant professors in 1977 had been promoted to a higher rank by 1981. Only half of the women assistant professors at these same schools were promoted during that period, the study found.

However, there are signs that the increases in the number of women in junior faculty positions that took place between 1973 and 1977 are now being reflected at the associate professor rank. The sex differential in tenure at the associate professor level also has narrowed since 1977, and at the assistant professor level, a slightly higher percentage of women than men now have tenure.

Sex differences in faculty salaries persist in most fields, the study finds, with the largest differences occurring in chemistry and medical sciences. Women assistant professors in chemistry earn, on average, $1700 per year less than men do, the study finds.

In industrial employment as well, women scientists and engineers have made substantial numerical gains in the four years covered by the study. From 1977 to 1981 their numbers more than doubled, from 1700 to 3500, although they still account for only 5% of all Ph.D.-level personnel in industry.

Women are gaining better foothold in universities . . .

	Women scientists and engineers as % of total	
	1977	1981
Professor	2.5%	3.1%
Associate professor	6.6	9.8
Assistant professor	16.1	23.5

. . . but still less likely than men to be promoted

	% promoted from assistant professor rank in 1977 to higher rank in 1981	
	Men	Women
Top 50 institutions[a]	73%	47%
Other institutions	70	57

a The top 50 institutions by federal R&D expenditures in fiscal year 1980. Source: National Research Council

Only 16.4% of the women scientists in industry say that their primary work activity is management, compared to 28.7% of men. Women in industry are more likely than men to be employed in basic research (12% of women, compared with 8% of men), consulting (10% of women, compared with 7% of men), writing (2% of women, compared with 1% of men), or "other activities" (16% of women, compared with 9% of men).

As it did four years ago, the committee has several recommendations for improving the status of women scientists and engineers. It urges science departments to give further attention to the rates of promotion of men and women within the department. "Much of the focus of affirmative action efforts in the past has been at the entry level. The findings of this report suggest a need to take that one step further and examine the comparative advancement of those hired as assistant professors," the committee says. Attention also needs to be given to the increasing number of women who are in off-ladder positions in academe.

Copies of the report, "Climbing the Ladder II: An Update on the Status of Doctoral Women Scientists and Engineers," are for sale for $8.95 (prepaid) from the National Academy Press, 2101 Constitution Ave., N.W., Washington, D.C. 20418. □

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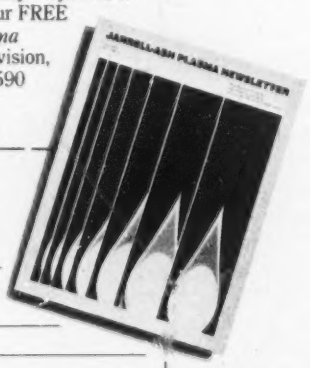

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